614.65
M5
B114

N. S. Vol. 1, No. 4. April, 1912.

BULLETIN

OF THE

Medical Library Association

QUARTERLY

N. S. Vol. 1, No. 4. April, 1912.

BULLETIN

OF THE

Medical Library Association

QUARTERLY

THE DISINFECTION OF BOOKS.*

BY L. B. NICE, Harvard Medical School.

Books seem well adapted for carrying small-pox, measles, scarlet fever, trachoma, diphtheria, erysipelas, dysentery, typhoid and tnberculosis. Yet so far as I have been able to find, no satisfactory method for the disinfection of books is being used anywhere in this country. Books are a particular diversion of invalids and convalescents, therefore they are in much danger of becoming infected. If a person sneezes or coughs, he is very apt to hold his book in front of him. By placing petri dishes around tubercular patients, Flügge (14) found that tubercle bacilli are thrown as far as a yard in the coughing, sneezing or even speaking of such persons. Besides the danger of contamination in these ways and in the ordinary handling of a book, many people persist in the uncleanly habit of moistening their fingers in their mouths when turning the leaves.

Scarlet fever has been carried to distant places by letters (11). A case is known where a mother and baby were fatally infected with septicemia from a book (11). In Bordeaux several people were attacked by a feverish lumbago after having rearranged the library books of the Faculty of Medicine (6). Letters written by small-pox patients infected the post-office officials in Kent, England (29). Most serious of all, an epidemic of tuberculosis occurred among the officials in the archives of Kharkow, Russia (11). The excise officer had been in the last stages of tuberculosis and had been in the habit of moistening his fingers with saliva as he handled the documents.

The length of time that the different pathogenic bacteria can withstand drying varies greatly. Krausz (15) placed bacteria from 48-hour-old cultures in books and kept them in the dark at room temperature. He found that cholera lived only 48 hours, whereas diphtheria lived 28 days, Staphylococcus 31, typhoid 40-95 days and tubercle bacilli 80-103 days. Other investigations confirm his results except in the case of tuberculosis and diphtheria. Abel (29) found that diphtheria bacilli retained their virulency on toys for six months and this is the length of time that Von Schab (27) gives. Lion (17) and Von Schab both say that tubercle bacilli withstand drying for six to nine months.

The number of bacteria that may be found on much used books was investigated by Lion (17). A novel from a public library varied from 250 bacteria per 100 square centimeters on the middle of a clean page to 1,250, 1,875 and 3,350 on the dirty edges. A college atlas showed from 650 to 1,075 per 100 square centimeters; an anatomy book 2,275 to 3,700. The bindings were by far the richest in bacteria, yielding on an average 7,550 per 100 square centimeters.

As to the pathogenic bacteria that may occur on books, the following investigations are of great interest. Krausz (15) inoculated seven guinea pigs with dirty pieces of paper from much used books and they all died of peritonitis.

Copyrighted by the author, 1911.

*This investigation was made at Clark University, Worcester, Mass.

The eighteen inoculated with pieces from clean books remained healthy. Du Cazal and Catrin (6) found staphylococcus pyogenes on an old book in a hospital. Most striking of all are Mitelescu's (20) experiments. He took 60 much used books that had been in a public library from six months to two years; he cut out the dirtiest parts, soaked them in salt solution, centrifuged the liquid and inoculated guinea pigs with the sediment. Nineteen died of septicemia and twelve of streptococcus infection. He repeated the experiment with thirty-seven books trom three to six years old. Fourteen of the guinea pigs died of septicemia and fifteen contracted tuberculosis. The damp dirt on the older books was a good medium for tubercle bacilli.

A book is a very difficult thing to disinfect. The method used must kill all the bacteria, must not injure the books and finally must be as easy to use and cheap as possible. The disinfectants that have been tried for books are steam, Pictet's gas mixture, formalin, carbo-gasoline, steaming formalin vapor under vacuum, dry hot air and moist hot air.

Steam fulfills the first requirement by killing all the bacteria, but unfortunately it is very injurious to books, especially to leather. It is recommended, however, by Abba (1), Du Cazal and Catrin (6), Krausz (15), Petruschky (22) and Rickards (23) who suggest that all school and library books should be stitched instead of glued and have as cheap covers as possible so that steam disinfection would not injure them very seriously.

Letters on the other hand do not suffer any bad effects from being autoclaved. This was the experience in the aforementioned small-pox epidemic in Kent; the letters were autoclaved, no more small-pox was disseminated and the letters themselves were uninjured. This was confirmed by experiments of my own.

Pictet's gas mixture—sulphuric acid and carbonic acid in equal parts—was tested as a book disinfectant by Von Schab (27), but he found it ineffective.

On account of the convenience of formalin as a disinfectant it has been adopted in many cases for books without due regard to its effectiveness for this purpose; Lehman (16), Englund (7), Lion (17) and Miquel (19) had apparently satisfactory results with formalin. However more exhaustive investigations by Du Cazal and Catrin (6), Van Ermengen and Sugg (26), Knopf (14), Von Schab (27), Barbe (3), Ballner (2) and Rickards (23) have proved conclusively that formalin will not kill bacteria in books. A gas will not penetrate between the leaves of a book no matter how ingeniously the book is held open.

In this country a device for general fumigation is the DePree formaldehyde fumigator. Mr. DePree told the writer that he recommends no penetrative qualities for formaldehyde gas and that it is therefore not adapted for book disinfection.

A new method has recently been suggested by Beebe (3) for disinfecting books by immersing them for 20 minutes in a 2% solution of carbolic acid in 88 Baüme gasoline. He smeared a small amount of a bouillon culture on the leaves, 50 pages apart, of previously autoclaved books. One book was infected and immediately immersed for 20 minutes in carbo-gasoline; then the infected areas were placed in bouillon. Two other books were allowed to dry for an hour after being infected; they were then immersed for 20 minutes, and cultures made immediately from one of them, whereas the other was allowed to dry over night before they were made. 18 inoculations were made of bacillus diphtheriae, 7 of staphylococcus pyogenes aureus, 18 of bacillus coli communis and 19 of bacillus

typhosus—a total of 62—without growth in any case. He also placed tuberculous sputum between the pages of books and immersed them in carbo-gasoline for 20 minutes. Three guinea pigs were inoculated with this sputum, and one contracted tuberculosis.

I tested this method using 88 Baüme gasoline saturated with carbolic acid (about a 2% solution). Books thoroughly dry after having been autoclaved were inoculated 20 pages apart with a loopfull of agar or bouillon cultures. The inoculated books were then placed in a sterile chamber for 48 hours so that the cultures would thoroughly dry to prevent any danger of their being washed off. Instead of 20 minutes they were left in the carbo-gasoline for one hour. They were then removed and allowed to dry for 96 hours to make sure that the gasoline would all evaporate. Cultures were then drawn off. 80 inoculations were made, 28 of bacillus diphtheriae, 27 of staphylococcus pyogenes aureus, and 25 coli communis. 55 of these grew: 25 of the diphtheria, 17 of the staphylococcus and 15 bacillus coli.

The next step was to determine whether saturated carbo-gasoline solution will kill bacteria when placed directly in contact with them. Nine test tubes containing slant agar cultures of bacillus diphtheriae, staphylococcus pyogenes aureus, and bacillus coli communis—3 of each—were filled with carbo-gasoline. This was removed after one hour and ten minutes. After 96 hours cultures were drawn off. Growth occurred in two of the staphylococcus cultures, one of the diphtheria and two of the bacillus coli.

By repeated tests it was found impossible to make a stronger solution of carbolic acid in gasoline than about 2%. So there seems to be no hope of modifying Beebe's method so as to make it effective. The only way that I can explain the lack of growth in Beebe's experiments is that his bouillon cultures must have been washed off by the gasoline since he did not thoroughly dry them. This is confirmed by my own experiments; for although they were well dried, only 25% of the bouillon cultures grew while 80% of the agar grew.

The three factors of formalin, vacuum and heat are combined by Kister and Trautman (12 and 13) in their method of disinfecting books. The books have to be held open; the temperature is 70° C. for two hours with a vacuum of 450 millimeters. This was further tested by Xylander (28) and also by Sobernheim and Seligman (25) and was found to disinfect books satisfactorily without injuring them. The apparatus consists of a formalin vaporizer, a disinfection chamber, a vacuum cylinder and an air pump. Although this method is effective, it is not very practicable; for only a few books can be disinfected at a time and the apparatus is complicated, expensive and difficult to manage.

Dry hot air at 140° C., when employed for a long time, will kill non-sporing bacteria, but such a high temperature is injurious to books. Mosebach (21) had good success in a few tests with dry air of 70°-80° for 14 to 24 hours, but Xylander (28) found that the least time necessary was 32 hours and that moisture supplied either by water or formalin shortened the disinfection time to 25 hours.

Moist hot air fulfills all the requirements for an ideal book disinfectant; for it kills all the bacteria, it does not injure the books and it is inexpensive and convenient to use. Several investigators worked along this line: Schumberg (24), who found that hot air of 100° C. and 55-65% moisture will kill bacteria without injury to leather; Ballner (2) who adopted this method for single closed books using a temperature of 95° C. and 40-60% moisture; and Berlioz (5) who, with a temperature of 95° C., supplied his moisture by a dish of formalin

and ethyl aldehyde. The perfecting of the moist hot air disinfection of books is due to Xylander (28) and Findel (9 and 10). Xylander's work was especially thorough and convincing, for he made considerably more than a thousand tests. 78° to 80° C. and 30 to 40% moisture for 32 hours will kill all non-sporing bacteria in closed books, even tubercle bacilli in thick layers, and does not injure the most delicate binding in any way, even after months of disinfection. Greater heat than 80° C. and more moisture than 40% is injurious to the books. When disinfecting a pile of books a small thermometer should be placed in a rather thick book in the middle of the pile. When this thermometer registers 70° C., which may take 11 hours, the disinfection may be counted as begun. It must continue for 32 hours in order to kill all the bacteria. I tested this method making 73 inoculations and obtained perfect success.

The apparatus necessary is simple. It consists of a double walled case of galvanized iron, with water filling the space between the walls. There are two doors, the inner of glass and the outer of galvanized iron. A thermometer and hygrometer are fastened to the inside of the glass door, so that they can be read without opening the apparatus. The shelves for the books may be of perforated galvanized iron or of wire. The moisture is supplied by a water pipe opening near the bottom of the disinfector so that the water drips slowly into a flat dish of porous material, such as unglazed clay or tile. This becomes saturated and gives up its moisture in the form of vapor. Heat is furnished from beneath by gas, gasoline, or oil burners. In such an apparatus, two feet wide, two feet deep and three feet high, 300 to 400 school books can be disinfected at one time.

In order to find out the condition of affairs in this country, letters were written to the Boards of Health of all the states and of all cities with a population over 100,000. They were asked what disinfectants and what methods they use in disinfecting contaminated school and library books. Only six answers mentioned library books; three of these said infected library books are destroyed; two, that they are fumigated with formalin, and one Board makes "daily reports to both school and libraries of all contagious disease matters," but it failed to state what action is then taken. As to school books 12 states and 10 cities do nothing at all; 9 states and 22 cities burn all contaminated books; 17 states and 25 cities use formalin; 2 states and one city use dry heat; 3 cities use steam and one state and 3 cities are trying carbo-gasoline. Of those using dry heat, one says merely "we use dry heat sterilizing," a second uses 140° C. for one hour, which according to all authorities is too short a time to kill the bacteria and besides injures the books. The third uses 80° C. for 2 hours. I tested this and the cultures grew in every case.

Only 9 states and 25 cities—those who burn and those who use steam—are taking proper precautions in regard to the danger of infection from scarlet fever, diphtheria, small-pox and occasionally measles. This is being done, however, at the sacrifice of the books. A significant fact is that not one of the 100 letters mentioned tuberculosis.

SUMMARY.

1. Books are known to have infected people with septicemia, feverish lumbago and tuberculosis. Letters have carried scarlet fever and small-pox.

2. Staphylococcus is able to withstand drying 31 days, typhoid bacilli 40 to 95 days, diphtheria one to 6 months, and tubercle bacilli 3 to 9 months.

3. Well used books have been found to have from 3,350 to 7,550 bacteria per 100 square centimeters.

4. Seven guinea pigs died of peritonitis when inoculated with pieces of dirty books. Guinea pigs were inoculated from 60 well used books that had been in a public library 6 months to 2 years. 31 died from septicemia and streptococcus infection. Other guinea pigs were inoculated from 37 books from 3 to 6 years old; 14 died from septicemia and 15 contracted tuberculosis.

5. Steam is an effective disinfectant but ruins the books.

6. Formalin is entirely untrustworthy as a disinfectant for books.

7. Dry hot air is not a satisfactory method.

8. Carbo-gasoline is absolutely inefficient as a book disinfectant.

9. Moist hot air at 80° C. and 30-40% humidity for 32 hours will kill all non-sporing bacteria in closed books, even tubercle bacilli in thick layers, and does not injure the most delicate binding in any way.

10. Boards of Health should make daily reports to the schools and libraries of all contagious diseases, including small-pox, measles, whooping cough, scarlet fever, typhoid, erysipelas, dysentery, diphtheria, venereal diseases and tuberculosis. Books that have been in the hands of such patients should be disinfected by the moist hot air method.

11. As a matter of precaution, especially against tuberculosis, it would be well if public library books that are much in use and all school books were disinfected by this method at regular intervals. Public school books should always be disinfected before given out to a new set of pupils.

12. When using a public library book one should realize that it may have been in the hands of some one suffering from tuberculosis or other disease. A wise precaution is to carefully wash the hands after using such a book. One should *never* moisten his fingers with saliva when turning leaves.

BIBLIOGRAPHY.

1. Abba. Sulla desinfecione dei libri. Rivista d'Igiene e Sanita Pubblica. 1900.
2. Ballner, Franz. Ueber die Desinfektion von Büchern, Drucksachen u. dgl. mittels feuchter heisser Luft. Leipzig, 1907.
3. Barbe. Désinfection des livres par les pulvérisations du formol du commerce. La *Presse Médicale*, Paris, Aug. 23, 1902. 10. p. 810.
4. Beebe, W. L. Carbo gasoline method for the disinfection of books. *J. Amer. Pub. Health Ass.*, Jan. 1911. Vol. 1. pp. 54-60.
5. Berlioz, Fernand. Désinfection des livres fermés. H. Daragon, Paris, 1907. 8 p.
6. Du Cazal and Catrin. De la contagion par le livre. *Ann. de l'institut Pasteur*. Paris, Dec., 1895, 9, No. 12. pp. 865-876.
7. Englund, Nils. Om formaldehyden. Hygenic Institute of Stockholm, 1895, 45 p. Abstract in *Hygienische Rundschau*. Berlin, 1896. 6 pp. 369-70.
8. Ficker, M. Fortschritte der Schulhygiene. Müller, Charlottenburg, 1910. pp. 51-53. 68 pp.
9. Findel. Desinfektion von Büchern, militärischen Ausrüstungsgegen ständen, Pelzen usw. mit heisser Luft. *Zeitschrift für Hygiene*. Leipzig, 1907, 57, pp. 83-103.
10. Findel. Deutsche Desinfektionszentrale, Berlin, 20.
11. Josias. De la transmission des maladies infectieuses par les livres. *Revue de Therapeutique*. Paris, 1906. 54. pp. 7-12.
12. Kister u. Trautman. Ueber Versuche mit Formaldehydwasserdampf nach dem Verfahren v. Esmarchs. *Zeitschrift für Hygiene*, Leipzig, 1904. 46. pp. 379-393.

13. KISTER u. TRAUTMAN. Ueber Desinfektionversuche mit Formaldehydwasserdampf. *Gesundheits-Ingenieurs*, Feb. 10, 1906. 29. No. 6. pp. 101-106.

14. KNOPF, S. A. L'infection des livres par le bacille de la tuberculose. *La Presse Médicale*. Paris, Feb. 24, 1900. 8. 16. pp. 70-71.

15. KRAUSZ, ARTHUR. Über die Infectionsfähigkeit und Desinfection von gebrauchten Büchern. *Zeitschrift für Hygiene*. Leipzig, 1901. 37. pp. 241-249.

16. LEHMAN, K. B. Vorlaüfige Mitheilung über die Desinfektion von Kleidern, Lederwaaren, Bürsten und Büchern mit Formaldehyd. *Münch. Med. Wochenschrift*. Munich, Aug. 8, 1893. No. 32. 40. pp. 597-599.

17. LION, ALEXANDER. Untersuchungen über den Keimgehalt und die Desinfection benutzter Bücher. Würzburg. *Stahel 'schen Buchdruckerei*, 1895. 32 pp.

18. LUCAS-CHAMPONIERRE. La désinfection des livres fermés et l'avenir des sterilisations. *Jour. de Médicine et de Chirurgie*. Paris, 79. 4th series. pp. 321-326.

19. MIQUEL, P. Sur un mode de désinfection des livres. *L'Hygiene générale et appliquée*. Paris, 1907. 2. pp. 650-658.

20. MITELESCU, J. Beiträge zur Aetiologie der Tuberculose. *Zeitschrift für Hygiene*. Leipzig, 1903. 44. pp. 397-406.

21. MOSKBACH, O. Untersuchungen zur Praxis der Desinfection. *Zeitschrift für Hygiene*. Leipzig, 1905. 50. pp. 485-501.

22. PETRUSCHKY, J. Experimental-Untersuchungen über Desinfektion von Akten u. Büchern. *Zeitschrift für Krankenanstalten*, Mar. 5, 1905. pp. 106-110.

23. RICKARDS, BERT R. The Disinfection of Books. *Amer. Jour. of Health*. Boston, 1908. N. S. 4. pp. 325-331.

24. SCHUMBERG. *Zeitschrift für Hygiene*. Leipzig, 1902. 41. p. 167.

25. SOBERNHEIM and SELIGMAN. Bücherdesinfektion. *Desinfektion*. 1910. No. 11. Cited in *Zeitschrift für Schulgesundheitspflege*, 1911. Nr. 2. pp. 135-136.

26. VAN ERMENGEN et SUGG. Recherches sur la valeur de la formaline à titre de désinfectant. *Archives de Pharmacodynamie*, Paris, 1895. 1. pp. 141-298.

27. VON SCHAB. Beitrag zur Desinfection von Leihbibliotheksbüchern. *Cent. für Bacteriologie u. Parasitenkunde*, 1897, 21. pp. 141-6.

28. XYLANDER. Die Desinfektion von Büchern mittels feuchter heisser Luft und gesattigten, niedrig temperierten, unter Vakuum strömenden Formaldehydwasserdampfen. *Arbeiten aus dem Kaiserlichen Gesundheitsamte*, Berlin, 1908. 29. pp. 288-312.

29. YOUNG, A. S. The disinfection of books. *The Sanitary Record*. London, Nov. 25, 1898. 22. pp. 561-562.

OPHTHALMIC LITERATURE.

An enterprise of considerable interest is that of Dr. Edward Jackson, who, with the assistance of Dr. William H. Crisp, edits and publishes Ophthalmic Literature which is entering in its second year. This is an attempt to replace the various year books, most of which have not succeeded for the want of support. Certain abstracts of ophthalmic literature will be published, but the majority of the publications consist of classified papers relating to diseases of the eye. The Ophthalmic Year Book will not be published any longer.

---

*Copyrighted by the author, 1911.

†From a manuscript in the author's collection.

INSECTS DESTRUCTIVE TO BOOKS.*

BY WILLIAM R. REINICK.

"The man who marks a borrowed book,
And makes the ends and corners look
Dog-eared and ragged and infirm,
He is an insect and a worm."

ELLA WHEELER WILCOX.†

It will be impossible in this lecture to go into details regarding the various series of experiments that have been made and studied in order to obtain the results, which I will speak of this evening, on account of the limit of time. Some of my remarks will appear to some researchers to be the words of one lacking an understanding of the groundwork of science, but in reply to those who doubt, I can only say, investigate along the same lines and the results will amply repay you for your time and labor.

Paste-eaters.—The statement previously made by me to the effect that the paste used in binding was often eaten by the larvæ of insects hatched from eggs that were originally in the flour, has been questioned on the ground that the heat necessary to boil paste, 212°, would have killed all life. How this challenge could have been made by anyone who had experimented on the vitality of eggs under adverse conditions is beyond my comprehension. They confuse the life that has hatched with the life within the egg. Heat no doubt would destroy the greater portion of the life that had hatched, but not always, as in the case of certain bacteria, who from their known power to withstand a high degree of heat, are popularly called heat-lovers. They have even stood the high temperature of steam for a number of hours. But aside from the imago state of the insect, the egg, in which the embryo passes through its various stages, has been overlooked, and experiments properly conducted will prove them capable of withstanding a temperature very much above that which the scientist of today has knowledge.

Anyone caring to investigate the life in the paste may easily do so in the following way: Boil the flour in the usual manner, adding the glue for the binder, and after allowing the mass to cool, let it stand in a dark, damp place. After it has become sour, it will be found that nature will again produce the same forms from it as she did when it was in the form of flour. Naturally, to give conclusive evidence, care must be taken to see that no insects are allowed to gain access to the paste from the outside, so as to avoid any possibility of their laying their eggs in the substance.

Bindings: Wood Bindings.—Books that are bound with wood covers are always subject to the borings of the insects that lived on the species of trees from which the boards are made, especially if the atmosphere is saturated with moisture, this being due to the porous nature of the wood. Take the point of a needle, touch the wood, and you find that it gives, showing that it is composed of cells containing gases. They are not only subject to attacks from without, but also from within; *i.e.*, larvæ hatching from eggs that were deposited in the tree

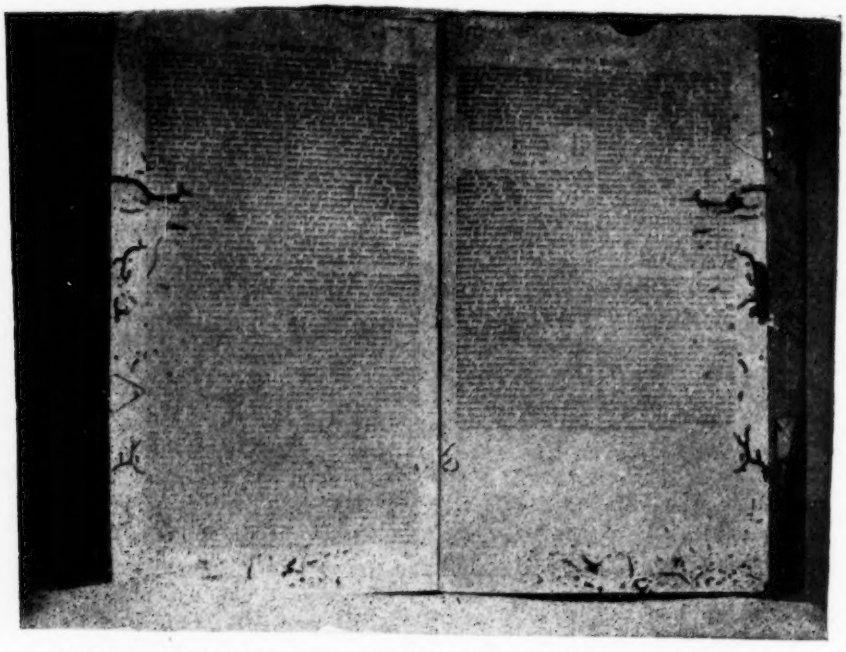
before it was made into lumber. The early stages of a number of species of wood-destroying insects take quite a long period to evolve.

The insects destroying wood bindings are species of *Bostrychidæ* and some of the *Scolytidæ*. One species of *Cerambycidæ* has been named as causing trouble, and as a large proportion of the species of this family are wood-borers, other species will likely be found to tunnel these covers.

Bindings: Leather Bindings.—The so-called dry rot of leather bindings said to be caused by the fumes in the air, especially where gas is used for lighting purposes, is also found to take place with leather-bound books that have not been exposed to such chemicals. Investigation will prove that instead of gases being the destructive agency, minute forms of life alone are the cause.

Another subject for future research is the cause of certain round holes, as though made by shot, often found in books bound in sheepskin. A careful examination of bindings showing these peculiar shot-like holes failed to show any galleries leading into or along the back of the books, which the *Coleoptera*, the insects named as committing these ravages, would make; and careful observation will reveal that instead of the holes being made by beetles, that a species of *Trichina*, a parasite which at present causes great losses to sheep-breeders, is the source. The skins, even after going through the various processes of tanning, still contain the same basic principles as in the primo state.

FIG. 1



Book from British Guiana. The volume is bored through by a species of *Coleoptera*.

Bindings: Printed Cloth Bindings.—These bindings, on account of the oils and greases used in their manufacture, are subject to the ravages of those insects which have use for such substances.

Species of *Blattidæ* and *Gryllidæ* are fond of these bindings.

Printing Inks.—While investigating the various printing inks, Mr. Thomas A. Bradley, President of the Security Bank Note Company, of Philadelphia, called my attention to the fact, that the working clothes of the employees of his company, if left hanging in a dark place for a time, were found to have been gnawed by the larva of some species of insect, and that the most striking part was, only that part of the clothing which had been stained with ink was eaten. Most inks contain one or more acids in their composition, and as they are claimed to be poisonous and therefore should kill, one would say that the parts of the goods discolored by the inks should be exempt from these attacks, instead of proving attractive. A French author writes of a book in which the insects had eaten the portion of the paper which had received the impress of the ink, showing that they were after something besides the paper, paste or binding.

To prove this, I took a piece of parchment—sheepskin and imitation—and a quantity of the finest grade of engraver's black printing ink, made a circle of ink in the centre with diagonal lines running from this to the corners and sides and a one-eighth inch border all around the edges. After the ink was dry, I placed a piece of each kind of parchment in a tin can with twelve roaches, adding water from time to time for drinking purposes. At the end of two weeks an examination of the parchment showed that the roaches had eaten all of the edges, had then followed the diagonal lines, eating mostly the portions so marked, and then the circle, showing that they knew the value to them of the acetic acid which was in the ink.

I hope that other experiments will be made along the same lines to ascertain if the various dyes, though often of the same color, are more secure from the inroads of insects than others, on account of containing certain chemicals in their composition. *Blatta orientalis* was the species used in making these experiments.

CONDITIONS FAVORABLE FOR THE PROPAGATION OF BOOK PESTS.

Darkness.—The majority of libraries generally keep a large number of their books upon stacks placed in a dark portion of the building, badly ventilated, and the only light available as a rule is from gas jets or incandescent lamps, which are only lighted when needed. This darkness (the necessary condition for the starting of all life), the more or less damp air which is found in these surroundings, the gases of various kinds in the air, and the fact that the books most seldom called for are kept in these locations, all combine to give favorable conditions for the propagation of these small forms of life without much chance of their being disturbed during the evolution of their life-cycle.

Gases.—It is known that quite an amount of poisonous gas is given off by the gas used for lighting purposes, and also from the breath of readers, and that if the room is not properly ventilated, a quantity is constantly floating in the air. As plant life is known to live upon this gas, so will the lower forms of life be found to exist to a greater or less degree upon them.

In the earlier stages of the earth's history, when the chaotic conditions were in full play and harmony, every form of life was crude and drawn to the grosser matter that surrounded it for its energies and principles of growth. From the sun emanates the rays that have acted on the earth's surface and its interior, generating various elements known to science to-day to the extent of some seventy elements. By the action of these heat rays in associating the waters of

the earth with these elements were generated gases, and these gases are the energies upon which the lower organic life lives.

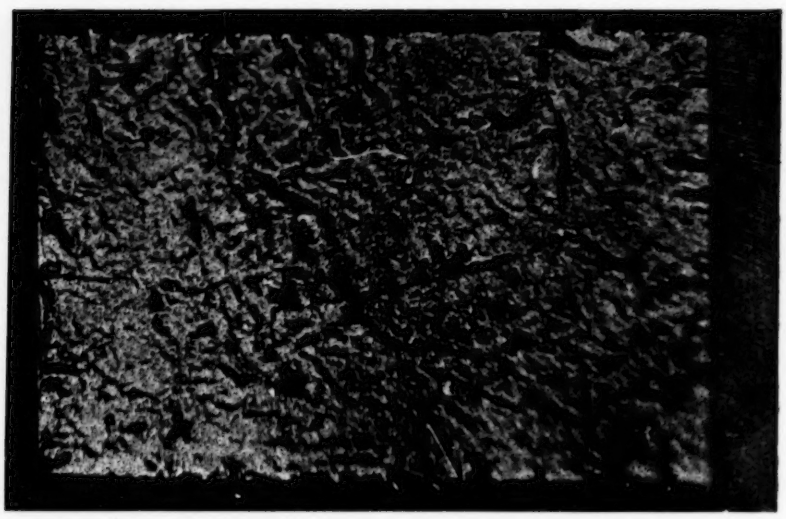
Man's body is a laboratory of life. While man uses intelligence in regards to poisons, the instinctive power of the little insect is used with greater care. Doctors will prescribe poisons and the patients take them without question, but the little insect uses its instinct to know what not to touch, and of those that it does partake, knows just how much to eat.

UNFAVORABLE CONDITIONS FOR THE INCREASE OF THESE INSECTS.

Light.—This, with cleanliness, are the two most important factors in preventing the ravages of insects among books, and will also prevent another sort of damage to books, which is the various kinds of fungi which start to grow upon and in the books a short time after they have been placed in a damp, warm atmosphere.

The lessening of the destruction of books by insects, that have been kept on shelves in badly-ventilated and badly-lighted libraries, after having been transferred to a new building having good ventilation and light, is ably illustrated by the experience of Mr. Ernest J. Reed, Librarian of the Oahu College, Honolulu, Territory of Hawaii. He stated in a letter to me that before the books were moved to the new building, the whole collection was constantly being riddled by various species of boring insects, but that since moving to the new quarters they are comparatively little troubled by pests. From an examination of samples of books I have received from him, I wonder how anyone was able to read the books with any degree of satisfaction, as many had hundreds of tunnels running through them, some had large cavities eaten in them, and others looked as though a mis-

FIG. 2



Volume from the Hawiian Islands. The cloth cover is almost entirely eaten, exposing in the strawboard the tunnels of *Catorama Mexicana*, a species of *Coleoptera*.

chievous boy had taken a pair of scissors and tried to see how many strips he could cut each leaf into; in others the cloth binding was almost entirely eaten off, exposing the galleries made by the beetles in the cardboard covers. (Illustrations Nos. 1 and 2.)

Books will also be found to have forms of life living upon them which at present cause much speculation as to what substance they feed upon, and the insects commonly known as book-lice, belonging to the family *Psocides* of the order *Corrodentia*, are examples. In turning over the pages of books or looking over papers which have been kept in a dark location for a long while, one with a keen eyesight will often see little specks of life run to a crevice to hide or get away from the rays of light. On account of their whitish gray color and an ability to run with a speed which is amazing when the size of the insect is considered, it is only the keen observer who will spy them as they scamper across the printed page. Though so small, they will be found to be the cause of a great deal of damage to books.

Many investigators think that the greatest damage is committed by the larger forms, whereas, as a rule, the smaller species, in proportion to their size, consume many times the amount of food as compared to that of the larger insect. I especially noticed this in making the experiment on artificial parchment herein mentioned, where twelve roaches, many of them females, big with eggs, at which time, of course, in order to provide the necessary supply of food for the coming generation, they would eat more than before the period of gestation, ate such a small amount of the paper that I spoke about it to a gentleman who was present when I examined the parchment. A fly in one day will consume food equal to its own weight. This is also illustrated by birds, who, in proportion to man, eat a far greater quantity of food.

Researches.—During the past year, I have made a number of experiments, and much against my will have arrived at the conclusion that as far as our present knowledge of the effects of poisons on these small forms of life is concerned, we have not even laid the foundation upon which to build.

The potato bug is an example. The paris green is placed on the plant in the morning, but at night the bugs are still there and seem to be eating the plant with more voracity than when it was absent. The chemical elements in the air and plant cause a reaction to take place, by which the poisonous qualities are lost, and instead of poison to kill, a substance to the liking of the insect is produced, as I discovered during my experience in farming.

Another source of error is the lack of positive knowledge as to the resistance of these minute forms to poisons, heat, pressure, etc., in their early stages. I have been taken to task for the statement made by me in my first paper as to mosquitoes hatching from eggs that have lain exposed for a long period of time, but I think that the following example of life remaining dormant under adverse conditions is more wonderful.

When I started to collect insects, I used for a cabinet a case of drawers which had been kept in a dry room of my home and had been in daily use for about twelve years, and placed it in an outside shed, the atmosphere of which was warm and damp. Some time after, upon looking at the contents of one of the drawers, I discovered a specimen of a large species of *Cerambycidæ* lying on the bottom and wondered where it came from. After searching on the outside and finding no opening, I pulled the drawer entirely out and discovered that the insect had emerged from the board used in making the side of the drawer, show-

ing that while the case remained in a dry location, the life remained dormant, going on with its life cycle when the proper conditions were given.

Seeds stored in a dry location for quite long periods have been known to produce plants when placed in the soil, and anyone familiar with bacteriology knows the great vitality of these forms, invisible to the naked eye. The smaller forms also have bodies more capable of withstanding supposed remedies than the larger insects. Take one hundred roaches and the same number of red ants, pour boiling water on them, count the number of survivors of each kind, and you will find that all or mostly all of the roaches will have been killed, while a large proportion of the ants are still alive; an interesting line of experimentation for economic entomologists.

Remedies.—I have received letters from almost every country of the world suggesting remedies, some claiming success, but the majority acknowledging defeat; in many cases what was proclaimed to be a specific remedy by one writer was declared to be a failure by others.

Even books, treated with the strongest poisons, failed to give the desired results, but on the contrary the remedies seemed to give the insects that they were supposed to kill a new lease of life. In the case of experiments conducted by the United States Bureau of Standards,* and also by myself, the roaches (the insects experimented with) produced their young as though nothing unusual was taking place. The roach, although said to have a wonderful instinct, really has less than the smaller forms of insect life. A famous remedy for destroying roaches is made of a combination of sulphur and sugar, the sulphur causing a luminosity when the bait is placed in the dark. The roach is attracted by the glow that deadens its instinct which would otherwise warn it against the poison, and it eats the bait; but the little ant's instinct, not being affected by the light given off by the sulphur, warns it of the danger, and as a consequence it seldom eats a poison that is placed near its haunts. This Bureau made a very large series of experiments in order to obtain, if possible, a binding material which would be exempt from the inroads of insects, and also to withstand the effects of light and gases without fading, and which Prof. S. W. Stratton, the Director of the Bureau, very kindly loaned me for study. The tests were made with cloths, ducks and buckrams of various colors. A portion of each piece was chemically analyzed in order to find what substances were used in their manufacture, and the rest of each sample was exposed to the roaches for various numbers of days. The results, when tabulated, proved that it did not seem to make any difference as to what materials were used in the coating, many of which were poisonous, as they had nibbled all but one of the bindings. They then tried impregnating some of the samples with a weak solution of quinine and others with strychnine, but these failed to give the desired immunity; and, upon increasing the quantity of the poison in the solution, the attractiveness of the substances was increased. Even corrosive sublimate was ineffective. It is true that the insects died within a few days, but not until they had ruined the bindings. One sample, seeming to be exempt from their ravages, was selected and adopted by the Bureau as a standard for binding the United States Congressional documents, and also accepted by the American Library Association Committe on Book-Binding as the best binding for library books.

---

*Memoranda relative to binding of publications for distribution to state and territorial libraries and designated depositories.—United States Congress, Washington, 1908.

During a conversation in the Government Printing Office last winter, while being shown the various materials used for binding Government documents, I expressed doubts as to the buckram approved, known as No. 666, being insect-proof; and this opinion has since been confirmed by experiments made by the Philippine Bureau of Science, Dr. Stratton and myself.

My own experiments with a poison of an entirely different character gave better results. One-half of each of the various kinds of binding materials tested was treated with my preparation and the other half left untouched. They were placed in boxes and exposed to the attacks of the roaches for various periods. Upon examination, I found that while the coloring matter in certain samples had been eaten on both the treated and untreated portions, the poisoned portions of quite a number of the others were left alone. In some cases pieces of the same color, although of different manufacture as regards to one sample, were eaten and the other piece was left undisturbed. The remedy used by me did not, to my knowledge, kill any of the insects. From a comparison of the results, I arrived at the conclusion that the material used for coating the buckrams, etc., in a number of cases, had neutralized the effective action of the preparation used by me, and that in order to really obtain a material that would be insect-proof, it would be necessary to use such coloring matters as would not overcome the benefical action of the poisons.

The fact that insects seem to show preference for certain colors used in binding materials, has already been noticed by a few of my correspondents; and also by myself while making researches in Florida last summer.

The Phillippine Bureau of Science, finding that the buckram used as a standard was not insect-proof in the Islands, made another series of experiments, and have produced material which they claim is absolutely safe, but as I have not received any samples to test, although I have made request for same, I am unable to pass judgement upon it.

Although scientists have been experimenting upon binding materials in order to obtain one that would be exempt from the ravages of these little insects, little has been done towards preserving the most important part, and which, according to my investigations, receives the greatest injury, namely, the printed portion of the book. Some experiments made by J. Rodway, Esq., Secretary of the Royal Agricultural and Commercial Society of British Guiana, with papers impregnated with sulphate of copper, turpentine, kerosene and corrosive sublimate, failed to stop the borings of the insects. I have sent boards and books made of different papers which I have treated with a substance to Mr. Rodway, and to other parts of the world, and the results as to the effectiveness of the remedy used should be received during the coming winter.

Arsenic in its various forms is used in large quantities in the materials used in book-making, though denied by the manufacturers; but chemical analysis will generally show the presence of this substance, which is of use to the insects. The elimination of arsenic in materials used in book-making would not only do away with a source of attraction to the insects, but save people from being poisoned, as anyone familiar with the literature of poisons knows.

Books as Disease Carriers.—Again, I speak upon the transmission of diseases by books, because the greatest disease carrier among insects that we know of to-day is the common house-fly, *Musca domestica*, which is also one of the book-destroying insects. There are a number of instances where the maggots of the fly have been found living upon paper, kept in damp places, but the

damage done directly to the book is as nothing when compared to the damage done by their transferring germs, and, unless means are taken for their extermination, they will rank first among book enemies, because those who know of the fly's ability to carry disease germs, will refuse to read any book which the fly has stained. The common house-fly is only found around the habitation of man, showing that it has evolved from some other form which formerly lived in the open until it has now become thoroughly domesticated, as other forms have done, are doing, and will do in the future.

According to Dr. Howard, a single female fly in the spring might, therefore, become the progenitor of 195,312,500,000,000,000 flies by the end of the summer or mid-autumn, and allowing one million flies to a bushel makes over 193 million bushels, each one of whom is capable of spreading contagion. An investigation made at the Agricultural Experiment Station at Storrs, Connecticut, in 1908, upon 414 flies, showed that the number of bacteria on a single fly may range all the way from 550 to 6,600,000, an average of one and one-fourth millions bacteria on each, an almost incredible number to be found on such a small object. The objectionable class, coli-aërogenes type, was two and one-half times as abundant as the favorable acid type. Now this only includes those on the outside, and every bacteriologist knows that large numbers are found in the intestines and expelled with the excreta. Mr. N. A. Cobb, in his article "The House-Fly,"* states that a well-fed fly defecates 104 times in less than two hours, and that spores were found in fifty-five of the specks. These specks, containing germs, are laid upon the covers or pages of the books, and as personal observation shows that a very large portion of readers moisten their fingers in turning over the leaves of a book, it is readily seen how the fly speck upon the the paper is moistened, adheres to the finger and the germs transplanted to the mouth, where they at once find the proper conditions and proceed to breed, resulting in the reader becoming afflicted with the disease, the source of which it is impossible to trace, on account of the slight consideration given by the medical world at the present time to books as a source of disease.

The danger of contracting disease by the fingers dampened with saliva in order to turn over the pages of a book is especially so in the case of persons suffering from tuberculosis, whose sputum contains millions of the bacilli. The saliva drying, the *Tubercle bacillus* clings to the fibre of the paper, and soon as another person, who also has the vulgar habit of wetting the fingers in turning the pages, uses the book, the germs are removed to fertile soil. Many other diseases, especially skin diseases, are without doubt frequently transmitted by this means.

In conclusion, I cannot speak strongly enough on the importance of cleanliness in preventing the destruction of books by insects, and the spreading of disease. The volumes in the library should be kept thoroughly cleaned, the attendants ought to clean their hands frequently, and the patrons compelled to wash their hands before using the publications and should not be allowed to wet the fingers in turning the pages. These precautions will help to decrease the spread of tuberculosis and other diseases, and do away with the grease stains on the paper, which are breeding grounds for germs and attractive feeding places for insects. Screens should be placed on all windows and doors to prevent the

National Geographic Magazine, vol. xxi, 1910, pp. 371-380.

entrance of flies, and by these means only will the destruction of the stores of accumulated knowledge be decreased and a source of death be overcome.

Theory Confirmed.—As this article goes to press, I have just obtained results from an experiment which goes to prove that books may be damaged by the hatching of life from eggs which were originally in the flour, or most likely, the grain.

In June, 1910, I obtained from Mr. James Stone, of Philadelphia, three samples of flour which he claimed were absolutely pure and each of the three varieties were placed in a sealed Mason jar and the jars put upon a shelf in a closet. They were thus kept in a dark location and also a dry atmosphere. At various times these jars were examined, but no sign of life appeared until the examination made October 6, 1911, at which time I was very astonished to find that two of the samples, "spring wheat flour" and "rye flour," were literally covered with what appears by looking through the glass of the jars to be a species of *Psocidæ* or book-lice. The third sample, "winter wheat straight," does not show any signs of life at the present time.

The results are quite startling, as it shows that the stages of some of these small forms take a period of time to evolve beyond our present knowledge, also that they did not need any oxygen to sustain them as the jars have never been opened since the flour has been placed in them, showing that the assertion made above, that many small forms live to a more or less extent upon gases supposed to be poisonous, had a foundation of truth. Lastly, that instead of one of the species known as grain-eaters appearing, that a species of *Psocidæ*, the habits of which are very little known, but I do not recollect that they have ever been classed as flour-eaters before, should appear in such immense numbers.

NOTE.—This article concludes the general outline of the divisons used by me, and I shall later publish a detailed account of each, giving descriptions and illustrations of the insects and examples of their work.

THE ANNUAL MEETING.

The 15th Annual Meeting of the Medical Library Association will take place in the Director's Room of the hotel Marlborough-Blenheim, Atlantic City, on June 3, at 8 P. M. There will also be a morning session from 10 to 12 A. M. on June 4. All the members are earnestly requested to be present if possible and take part in the meeting. Titles of papers should be sent immediately to the office of the Bulletin, 1211 Cathedral Street, Baltimore, Md.

BULLETIN

OF THE

MEDICAL LIBRARY ASSOCIATION

EDITED BY

JOHN RUHRÄH, M. D. MISS M. C. NOYES

Address all communications to the
Bulletin of the Medical Library Association, 1211 Cathedral Street,
Baltimore, Md.

VOL. I. APRIL, 1912. NO. 4.

DR. JOHN H. MUSSER.

It is with great regret that we announce the death of Dr. John H. Musser, for three years president of the Medical Library Association, who died suddenly at his home on April 3, 1912. Dr. Musser always took a great interest in the work of the Association, and while president was very active in futhering its interests, giving cheerfully both of his time and money. When one considers the large number of other activities which Dr. Musser had, his interest in and devotion to the cause of the Association seems very remarkable. In his death the Association loses the one who has done the most to further its interest during recent years, and those of us who came in personal contact with him feel the loss keenly. A biographical account will be printed in the next number of the Bulletin.

"WANTS" OF MEMBERS.

Kindly notify the manager of the Exchange at once if you can supply any of the following:

Amer. Jour. Anatomy.	v. 4, 1905, no. 1, 3, 4; v. 8, 1908, no. 3.
Amer. Jour. Med. Sciences.	O. S. v. 8, 1831; v. 13, 1833; v. 14, v. 15, 1834; v. 16, 1835; v. 21, 1837; v. 22, v. 23, 1838; v. 24, v. 25, 1839; v. 26, 1840; N. S. v. 1-9, 1841-1845; v. 11-14, 1846-1847; v. 18, 1849; v. 19, 1850, no. 39; v. 20, 1850; v. 20, 1850, no. 40, 41; v. 39-46, 1860-1863; v. 58, 1869; v. 141, 1911, no. 1.
Amer. Jour. Obstetrics.	v. 1-10, 1868-1877; v. 31, 1895; v. 35, 1897; v. 36, 1897; v. 37, 1898; v. 41, 1900; v. 43, 1901; v. 52, 1905; v. 55, 1907; v. 57, 1908 to date.
Anatomischer Anzeiger.	v. 18, 19, 20, 23, 31 and Index.
Archiv für Hygiene.	v. 72, 1910.
Archives de Medicine des Enfant.	v. 1-11, 1898-1908.
Archives of Pediatrics.	v. 1, 1884, no. 2-5, 6-12; v. 2, 1885, no. 1-3, 5, 12; v. 3, 1886, no. 3-9; v. 4, 1887; v. 5, 1888, no. 1-3, 6-12; v. 6, 1889; v. 10, 1893, no. 3-12; v. 11, 1894; v. 12, 1895, no. 1-8, 9-12.
Boston Med. and Surg. Journal.	v. 67, 1862; v. 125, 1891; v. 144, 1901; v. 150, 1904, no. 3, 4, 14; v. 158, 1908, no. 10; v. 159, 1908, no. 2.
British Journal of Children Dis.	v. 1, no. 2, 3; v. 3.
University of Buffalo Laboratory, Reports of the.	No. 1.
Chicago Pathological Soc., Transactions of	v. 5, no. 5.
Cornell Univ., Studies for Dept. of Pathology of.	v. 1, 2, 4, 5.
Detriot Med. Journal.	v. 1, 1877; v. 2, 1878; v. 3, 1879.
Harvard Univ., Report of Cancer Commission of.	Reports 1 and 11.
Interstate Med. Jour.	v. 7, 1900, no. 1, 2, 4-12; v. 9, 1902, no. 1-4, 6, 12; v. 11, 1904, no. 2-9, 11, 12; v. 12, 1905, no. 1, 2, 4, 5, 6; v. 13, 1906, no. 1; v. 16, 1909, no. 2-12; v. 17, 1910, no. 1-10, 12.
Jahrbuch fur Kinder-heilkunde.	v. 1-31, 1868-1892; v. 42, 1896; v. 45, 1897; v. 51-63, 1900-1906; v. 65, 1907; v. 71, 1910, no. 1, 2, 3.
Johns Hopkins Hospital Report.	v. 6, 1897, v. 9, 1900; v. 12, 1904; v. 13, 1906; v. 14, 1906; v. 15, 1910.
Jour. Biological Chemistry.	v. 1, 1906, no. 4, 5, 6; v. 1-4; v. 2, 1906, no. 2, 4, 6; v. 6, no. 1, 2, 3; v. 7, no. 1, 2; v. 9, no. 5.
Jour. Experimental Medicine.	v. 7, 1905, no. 6.
Jour. of Med. Research.	v. 1-8, 11; 13; 14; 15; 16, 18, no. 2, 4; v. 20, no. 2; v. 22, no. 14.
Jour. of the Missouri State Med. Assoc.	v. 7, 1910, no. 6.
Jour. of Nervous and Mental Diseases.	v. 34, 1907, no. 12; v. 37, 1910, no. 7, 9.
Jour. of the society of chemical industry.	v. 28, 1909, no. 4.

Lakeside Hosp. Clinical & Pathological Papers of.	v. 1.
Lancet.	v. 2, 1906, July 28.
Maryland Medical Jour.	v. 32, 1894-95, no. 27; v. 34, 1895-96, no. 27; v. 47, 1904, no. 3.
Mass. General Hosp.	v. 1, no. 2.
Monatschrift fur Kinderheilkunde.	v. 9, 1910.
National Hosp. Record.	v. 1-date.
New York Pathological Society Trans. of the.	v. 1, no. 1; v. 2, no. 6; v. 3, no. 4; v. 4, no. 6; v. 7, no. 2, 3, 4.
Pediatrics.	v. 1, 1896, no. 1-4, 5-8; v. 3, 1897; v. 13, 1902; v. 17, 1905, no. 1-3, 10, 12; v. 19, 1907, no. 1-10; v. 21, 1909, no. 4, 6, 7; v. 22, 1910, no. 1, 4.
Post-graduate.	v. 1; v. 2, no. 1-3, 5; v. 3, no. 2, 4, 5, 6; v. 4, no. 1-3, 5, 6; v. 5, no. 1-3, 5, 6; v. 6, no. 1, 3, 6; v. 7, no. 2, 6, 8; v. 8, no. 1, 4-7, 9, 10; v. 9, no. 1-7, 9-12; v. 10, no. 1, 2, 12; v. 11, no. 1-5, 8-10.
Philadelphia Path. Soc., Proceedings of.	v. 1-11.
Quarterly Jour. of Medicine.	v. 1, 1867; v. 2, 1868, no. 5-7; v. 4, 1870, no. 15.
Revue des Maladies de L'Enfance.	v. 1-7; v. 23, 1905 to date.
Scientific American.	v. 93, 1905, no. 24, 26, 27; v. 96, 1907, no. 1; v. 100, 1910, no. 3, 16.
Soc. for Study of Diseases of Children, Report of.	v. 1, 1902-v. 8, 1909.
Trans. of the Amer. Pediatric Society.	v. 21, 1909.
Zeitschrift für Allegemiene Physiologie.	v. 10, 1909.

DUPLICATES.

A member desiring any of the following should notify the Manager of the Exchange at once.

Andral, G.	Diseases of the chest. 1843.
Bartholow, Roberts	Materia medica and therapeutics. 3ed. 1879.
Decosta, J. M.	Medical diagnosis. 2ed. Phila., 1866.
Ehrlich, P.	Histologie u. klinik d. blutes. Berlin, 1891.
Erichsen, John	Science and art of surgery. 5ed. 1869.
Flint, Austin	Physiology of man. 1ed. N. Y. v. 2-4, 1867-1873.
Graham, Thomas	Elements of chemistry. 1843.
Howell, W. H.	An American text book of physiology. Phila., 1896.
Kirkes, W. S.	Handbook of physiology. 5ed. 1904, N. Y.
Polk, R. L.	Medical and surgical record. 1890. (2 copies).
Vierordt, Oswald	Medical diagnosis. 2ed. Phila., 1891.
Winslow, Forbes	Diseases of the brain. 1ed. Phila., 1860.